
TEST CONDITIONS FOR ENERGY STAR® COMPLIANCE MEASUREMENT FOR COMPUTERS

In order to reduce confusion and increase consistency, the following protocol should be followed when measuring power consumption levels of computers for compliance with the ENERGY STAR Computer Memorandum Of Understanding (MOU).

Outlined below are the minimum test conditions that should be established when performing the power measurement. These are necessary in order to ensure that ENERGY STAR compliance is based on common characteristics of computers.

A description of the test conditions and a discussion of testing equipment can also be found below.

I. TEST CONFIGURATION

Power consumption of a computer shall be measured and tested from an AC source to the system. Partner must measure a representative sample of the configuration that it ships to the customer, but the Partner does not need to consider power consumption changes that may result from component additions made by the computer user after sale of product. As described in the MOU, there are two guidelines under which a Partner can qualify a computer as ENERGY STAR-compliant. Partners can choose either Guideline A OR Guideline B for testing compliance.

II. TEST CONDITIONS

Line Impedance: < 0.25 ohm
Total Harmonic Distortion: < 5%
Input AC Voltage¹: 115 VAC RMS +/- 5V RMS
Input AC Frequency¹: 60 Hz +/- 3 Hz
Ambient Temperature: 25 deg. C +/- 3 deg. C

III. TESTING EQUIPMENT

The goal is to accurately measure the true power consumption² of the computer. This necessitates the use of a true RMS wattmeter. There are many models to choose from, but Partners will need to exercise care in selecting an appropriate model. The following factors should be considered when purchasing a meter and setting up the actual test.

¹ If products will be sold in Europe or Asia, testing should also be performed at the appropriate machine-rated voltage and frequency. For example, products destined for European markets might be tested at 230 V and 50 Hz.

² True power is defined as the product of the voltage, current and the power factor (volts x amps x power factor), and is typically reported as Watts. Apparent Power is defined as the product of voltage and current (volts x amps) and is usually expressed in terms of VA or volt-amps. The power factor for equipment with switching power supplies is always less than 1.0, so true power is always less than apparent power.

Crest Factor³

Computers that contain switching power supplies draw current in a waveform different from typical sinusoidal current. While virtually any wattmeter can measure a standard current waveform, it is more difficult to select a wattmeter when irregular current waveforms are involved.

It is critical that the wattmeter selected be capable of reading the current drawn by the computer without causing internal peak distortion (i.e., clipping off the top of the current wave). This requires a review of the meter's crest factor⁴ and of the current ranges available on the meter. Better meters will have higher crest factors, and more choices of current ranges.

When preparing the test, the first step should be to determine the peak current (amps) associated with the computer being measured. This can be accomplished using an oscilloscope. Then a current range must be selected that will enable the meter to register the peak current. Specifically, the full scale value of the current range selected multiplied by the crest factor of the meter (for current) must be greater than the peak current reading from the oscilloscope.

For example, if a wattmeter has a crest factor of 4, and the current range is set on 3 amps, the meter can register current spikes of up to 12 amps. If measured peak current is only 6 amps; the meter would be satisfactory. The other concern to be aware of is that if the current range is set too high in order to register peak current, it may lose accuracy in measuring the non-peak current. Again, with more current range choices and higher crest factors, manufacturer will get better results.

Frequency Response

Another issue to consider when selecting a wattmeter is the frequency response rating of the meter. Electronic equipment that contains switching power supplies causes harmonics (odd harmonics typically up to the 21st). These harmonics must be accounted for in power measurement, or the power consumption data will be inaccurate. Accordingly, EPA recommends that Partners purchase wattmeters that have a frequency response of at least 3 kHz. This will account for harmonics up to the 50th, and is recommended by IEC 555.

Resolution

Partners should choose a meter that can provide resolution of 0.1 W.

Accuracy

Catalogues and specification sheets for wattmeters typically provide information on the accuracy of power readings that can be achieved at different range settings.

³ The crest factor for a sinusoidal 60 Hz current waveform is always 1.4. The crest factor for a current waveform associated with a computer containing a switching power supply will always be greater than 1.4 (though typically no higher than 8). The crest factor of a current waveform is defined as the ratio of the peak current (amps) to the RMS current (amps).

⁴ The crest factor of a wattmeter is often provided for both current and voltage. For current, it is the ratio of the peak current to the RMS current in a specific current range. When only one crest factor is given, it is usually for current. An average true RMS wattmeter has a crest factor in the range of 2:1 to 6:1.

Calibration

To maintain their accuracy, wattmeters should be calibrated with a standard that is traceable to the U.S. National Bureau of Standards (NBS).

Continuing Verification

This testing procedure (protocol) describes the method by which a single unit may be tested for compliance. An ongoing testing process is highly recommended to ensure that products from different production runs are in compliance with the MOU. A model may qualify as ENERGY STAR-compliant if testing indicates that 95 percent of the units sold under this model name/number will meet the specifications contained within the MOU.